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GB 1561862 A JP 540067641 A US 4292143 A
US 4225346 A

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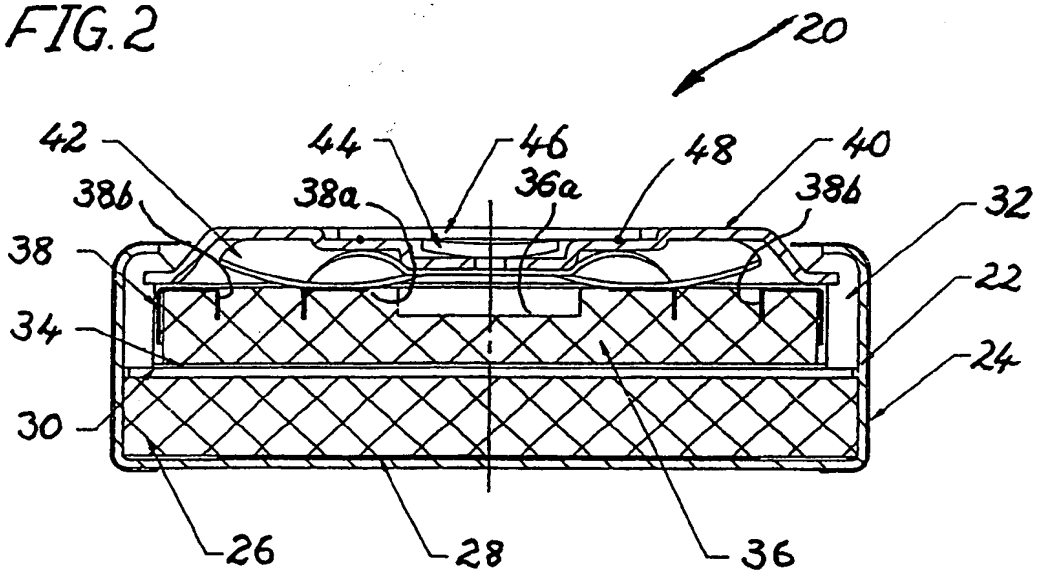
(54) Batteries

(57) In a nickel cadmium button cell (20)1) the positive electrode (26) is rigid and is manufactured by a sintering process such as to produce a positive electrode fabricated of a rigid porous matrix, the matrix being impregnated with nickel hydroxide resulting in high conductivity; 2) The negative electrode 36 comprises dish-shaped collector having flanged apertures 38b which key into a compacted mixture of powdered cadmium oxide; and 3) a half-height gasket 32 surrounding the negative electrode 36 to isolate it from the casing and pressing through the separator 30 against the rigid positive electrode 26 to create a seal preventing liquid electrolyte moving to the base of the battery.

FIG.2



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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FIG.1

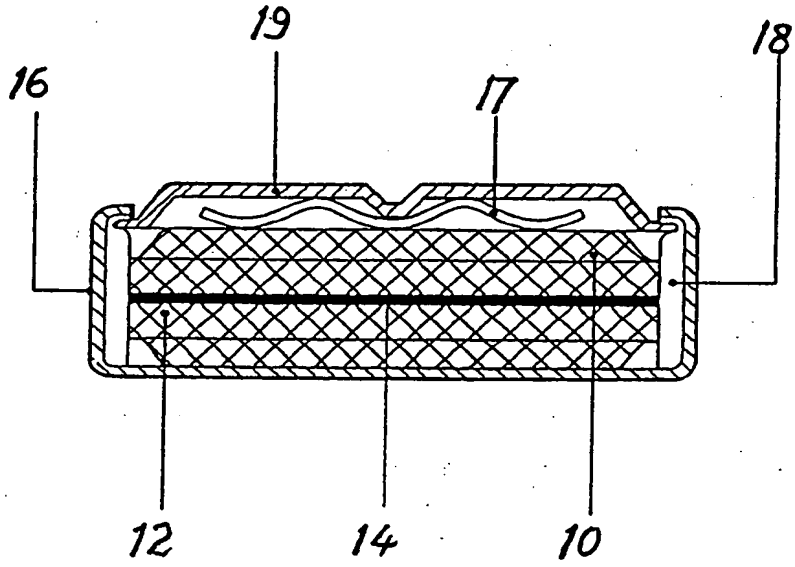
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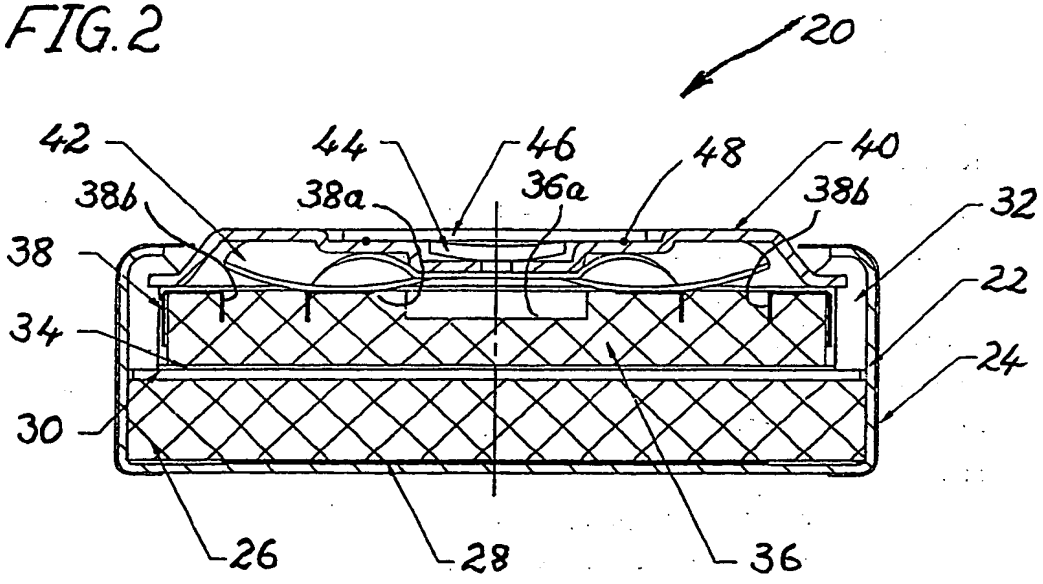
FIG.2


20
42
44
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48
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38b
38a
36a
38b
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36

BATTERIES

This invention relates to a battery, in particular, but not exclusively, to a nickel cadmium button cell.

Nickel cadmium button cells are well known. They may be used to power calculators, T.V. remote control units etc.

Figure 1 shows a known nickel cadmium button cell, comprising negative and positive screen wrapped electrodes 10 and 12, respectively, separated by a separator 14. These are mounted within an anode cup 16 and separated therefrom by a gasket 18. A contact spring 17 ensures contact between a sealing cathode cap 19 and the electrodes. Conventionally the electrodes are in a powder form and encased in a nickel wire frame. This type of electrode is known as a mass type electrode.

One of the problems of this type of nickel cadmium cell is that the separation and sealing between the electrode can sometimes be dubious.

According to one aspect of the present invention there is provided a positive electrode for use in a battery, comprising a porous sintered matrix structure capable of being impregnated with an activating chemical.

Some of the advantages of this type of electrode are that it has better conductance than conventional electrodes and it is considerably more rigid.

According to a second aspect of the present invention there is provided a method of manufacturing a positive electrode, for use in a battery, comprising the steps of compressing a mixture of nickel particulate and vaporised filler material; sintering the mixture to form a porous nickel matrix from which at least part of the filler has been vaporised; impregnating the matrix with an activatable compound and activating the compound in the matrix.

Some of the advantages of this method are that the electrode which is produced is more rigid and has electrodes of better conductivity than conventional electrodes.

According to a third aspect of the present invention, there is provided a negative electrode for use in a battery, comprising a dish-shaped collector having a plurality of flanged apertures therein whose

flanges project into the interior of the dish-shape, and a powdered electrode material compacted into the dish-shape of the collector.

Some of the advantages of such an electrode are that the collector is expected to be cheaper than a conventional wire screen wrap collector, that the electrode is expected to be more economical to produce, that the flanges key into the compacted mixture and reduce expansion and absorption of electrolyte.

According to a fourth aspect of the present invention there is provided a battery comprising a housing including a positive and negative electrode each with a collector associated therewith, one or more separators between the electrodes, and a gasket surrounding the negative electrode for isolating the negative electrode from the housing, wherein the gasket presses, through the separator, against the positive electrode. This battery preferably has a positive electrode according to the first aspect of the invention, and preferably has a negative electrode according to the third aspect of the invention. Thus since the positive electrode is rigid the gasket can press against the electrode, thereby sealing the electrolyte in the separator such that it cannot seep between the battery case and the positive electrode. The gasket may be half the height of the battery case thereby allowing more room for the active elements of the battery.

Some of the advantages of the battery include an improved positive electrode, improved sealing between the positive and negative electrodes and greater internal capacity for effective components. Also, the half height gasket allows a greater area of contact between the positive electrode and the housing, whereas, in the conventional battery, the gasket separates the peripheral edge of the positive electrode from the housing.

Reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a cross section of a known nickel cadmium button cell;

Figure 2 is a cross section of an embodiment of a nickel cadmium cell according to the invention.

Referring to Figure 2 a re-chargeable battery is shown generally at 20. The battery 20 comprises a body can 22 which is covered by a P.V.C. cover 24 along the sides of the body can. A collector 28 is

spot welded to the base of the body can and a positive electrode located on the collector in the base of the body can. A separator 30 is placed over the positive electrode. A half height gasket 32 is then placed on top of the separator. A second separator 34 is then applied to the first separator. A negative electrode 36 is then placed in the space defined by the gasket and the separators. The negative electrode includes a collector 38. The top cap 40 is then fitted. The top cap includes a contact spring 42, a vent plug 44 and a cover plate 46. The cover plate is spot welded by spot welds 48 to the top cap. When the separator 30 has been fitted into the battery, electrolyte is dripped onto the separator.

The positive electrode is not made in the conventional way. In the conventional method compressed nickel hydroxide powder is wrapped in a nickel wire mesh. The powder can tend to fall out of the wire mesh and settle at the base of the battery.

The positive electrode 26 in this embodiment of the invention is manufactured in the following way. Nickel powder, nickel fibre and Polyvinyl Butyral Resin (P.V.B.) are mixed together. The relative proportions being approximately 70% nickel powder, 15% nickel fibre and 15% P.V.B. The mixture is then compressed into disc form, the density of which is about 1800 to 2000 kg/m^3. The disc at this stage is relatively soft and brittle. The disc is then sintered at about 980^0C for about seven minutes in the presence of nitrogen and hydrogen gas. This causes the nickel powder and nickel fibre to be fused or welded together and the P.V.B. to vaporise. The disc at this stage is rigid and porous. The disc is then soaked in nickel nitrate which is absorbed since the disc is porous. The nickel nitrate is then crystallised by drying and cooling the disc. The disc is then soaked in sodium hydroxide, and the nickel nitrate is converted into nickel hydroxide. The disc is then washed to remove any traces of sodium hydroxide. The disc may then be charged with electricity to activate the nickel hydroxide in the disc. The porous matrix structure of the positive electrode, prior to impregnation, is caused by the addition of P.V.B. to the nickel powder and fibre in the sintering process. The sintering vaporises the P.V.B. resulting in a porous but rigid matrix structure which is then impregnated with nickel hydroxide. The positive electrode formed in the above described manner, generally, is

of better conductivity and structural integrity than previous known positive electrodes.

The collector 38 for the negative electrode 36 is in the form of an inverted dish of nickel-plated iron having a central aperture 38a and a plurality of (for example four) downwardly flanged apertures 38b around the central aperture 38a. The cadmium oxide mixture for the negative electrode, which may be conventional, is compressed into the dish shape of the collector 38, which is designed to contain the compacted mixture which would otherwise be prone to crumble. The collector 38 therefore replaces the wire screen wrap of a conventional electrode. The flanges of the flanged apertures 38b key into the compacted mixture, reduce expansion and absorption of electrolyte, and improve conductance between the electrode 36 and collector 38. It is expected that the collector 38 described above will be cheaper to produce than the conventional wire screen wrap, and the manufacturing process of the negative electrode 36 will be more economical than that of the conventional negative electrode.

The battery described will generally have better sealing between positive and negative electrodes than previously disclosed batteries. The half height gasket sits on and is pressed against separator 30 which in turn lies on top of the rigid positive electrode thereby creating a seal preventing the liquid electrolyte from moving to the base of the battery where it could be ineffective. In an ordinary nickel cadmium button cell the liquid electrolyte would move through the gap between the edge of separator and the gasket and actually between the wire mesh making up the electrode. Thus a half-height electrode would not be possible because the positive electrode consists of compressed nickel hydroxide powder wrapped in nickel wire and is not rigid. An additional advantage of the half height gasket is that is allows for greater space in the interior of the battery.

The vent plug 44 is resealable and is disclosed in co-pending patent application GB 9101365.6. The central aperture 38a in the collector 38 of the negative electrode 36, and a central pit 36a in the negative electrode 36 aligned with the aperture 38a facilitate the release of gases from the negative electrode for venting through the vent.

CLAIMS

1. A positive electrode for use in a battery, comprising a porous sintered matrix structure capable of being impregnated with an activating chemical.

2. A positive electrode according to claim 1, wherein the matrix is a nickel matrix.

3. A positive electrode according to claim 1 or 2, wherein the matrix is impregnated with nickel hydroxide.

4. A positive electrode according to any preceding claim, wherein the electrode is disc shaped.

5. A positive electrode for use in a battery substantially as described with reference to the drawings.

6. A method of manufacturing a positive electrode, for use in a battery, comprising the steps of compressing a mixture of nickel particulate and vaporised filler material; sintering the mixture to form a porous nickel matrix from which at least part of the filler has been vaporised; impregnating the matrix with an activatable compound and activating the compound in the matrix.

7. A method according to claim 6, wherein the mixture contains 15% of filler and 85% of nickel particulate.

8. A method according to claim 6, wherein the nickel particulate comprises nickel powder.

9. A method according to any of claims 6 to 8, wherein the nickel particulate comprises nickel fibre.

10. A method according to any of claims 6 to 9, wherein the nickel particulate comprises 70% nickel powder and 15% nickel fibre.

11. A method according to any of claims 6 to 10, wherein the filler

is Polyvinyl Butyral Resin (P.V.B.).

12. A method according to any of claims 6 to 11, wherein the activatable compound is nickel hydroxide.

13. A method according to any of claims 6 to 12, wherein the matrix is sintered at about 980°C for about seven minutes in an atmosphere of Nitrogen gas and Hydrogen gas.

14. A method according to any of claims 6 to 13, wherein the matrix is impregnated with nickel hydroxide by:-

soaking the matrix in nickel nitrate;
drying and cooling the matrix;
subsequently soaking the matrix in sodium hydroxide; and
washing the matrix to remove the sodium hydroxide.

15. A method according to any of claims 6 to 10, wherein the compound is activated by charging it with electricity.

16. A method of manufacturing a positive electrode, for use in a battery, substantially as described with reference to the accompanying drawings.

17. A positive electrode for use in a battery manufactured by a method as claimed in any one of claims 6 to 16.

18. A negative electrode for use in a battery, comprising a dish-shaped collector having a plurality of flanged apertures therein whose flanges project into the interior of the dish-shape, and a powdered electrode material compacted into the dish-shape of the collector.

19. A negative electrode as claimed in claim 18, wherein the collector has a vent aperture and the compacted electrode material has a recess adjacent the vent aperture.

20. A negative electrode for use in a battery, substantially as described with reference to the drawings.

21. A battery comprising a housing including a positive and negative electrode each with a collector associated therewith, one or more separators between the electrodes, and a gasket surrounding the negative electrode for isolating the negative electrode from the housing, wherein the gasket presses through the separator against the positive electrode.

22. A battery according to claim 21, wherein the battery is a dry cell.

23. A battery according to claim 21 or 22, wherein the battery is a nickel cadmium cell.

24. A battery according to any of claims 21 to 23, wherein the battery is a button cell.

25. A battery according to any one of claims 21 to 24, wherein the positive electrode is as claimed in any of claims 1 to 5 and 17.

26. A battery according to any one of claims 21 to 25, wherein the negative electrode is as claimed in any of claims 18 to 20.

27. A battery substantially as described with reference to the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9105753.9

Relevant Technical fields

(i) UK Cl (Edition K) H1B

(ii) Int Cl (Edition 5) H01M

Search Examiner
M.J. INSLEY

Databases (see over)

(i) UK Patent Office

(ii) Online database: Derwent WPI

Date of Search
11 June 1991

Documents considered relevant following a search in respect of claims 1-5

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1561862 (DAIMLER-BENZ) - Whole document	1-3 at least
X	US 4292143 (YARDNEY ELECTRIC) - Whole document	1-3 at least
X	US 4225346 (BELL-TELEPHONE) - Whole document	1-3 at least
X	JP 54067641 (JAPAN STORAGE BATTERY) - See Derwent abstract No. 79-51474B/28	1-4 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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